US006130380A

United States Patent [19]

Nakamura

[11] Patent Number: 6,130,380

[45] Date of Patent: Oct. 10, 2000

[54] **SOLAR CELL AND FABRICATION METHOD THEREOF**

[75] Inventor: **Kazuyo Nakamura**, Nara, Japan

[73] Assignee: **Sharp Kabushiki Kaisha**, Osaka, Japan

[21] Appl. No.: **09/066,822**

[22] Filed: **Apr. 28, 1998**

[30] **Foreign Application Priority Data**

Apr. 28, 1997 [JP] Japan 9-111190
Sep. 10, 1997 [JP] Japan 9-245556

[51] **Int. Cl.**[7] **H01L 31/06**

[52] **U.S. Cl.** **136/255**; 136/258; 136/261; 438/87; 438/96

[58] **Field of Search** ..... 136/258 AM, 255, 136/261; 438/83, 87, 96

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,837,607	6/1989	Kemmer et al.	357/30
5,543,333	8/1996	Holdermann	136/256 X
5,738,732	4/1998	Nakamura et al.	136/255

FOREIGN PATENT DOCUMENTS

0680099A2	11/1995	European Pat. Off.	H01L 31/18
0693787A2	1/1996	European Pat. Off.	H01L 31/068
0 735 597 A2	10/1996	European Pat. Off.	H01L 31/068
8-330611	12/1996	Japan	H01L 31/04

OTHER PUBLICATIONS

"An Optimization Study of Si Point–Contact Concentrator Solar Cells," R.A. Sinton et al., 19th IEEE PVSC, 1987, pp. 1201–1208.

"35% efficient nonconcentrating novel silicon solar cell," Jianming Li et al., Appl. Phys. Lett, vol. 60, No. 18, May 4, 1992, pp. 2240–2242.

"A New$^+$PN$^+$Structure with Back Side Floating Junction for High Efficiency Silicon Solar Cells," Moustafa Y. Ghannam, 22nd IEEE PVSC, 1991, pp. 284–289.

Primary Examiner—Bernard Codd

Attorney, Agent, or Firm—Birch, Stewart, Kolasch & Birch, LLP

[57] **ABSTRACT**

In a solar cell, a crystal defect layer by ion implantation or an amorphous layer by ion implantation is formed between p type diffusion layers provided in an island-like manner at a side opposite to a light receiving surface of a low concentration p type semiconductor single crystalline substrate. The element of the ion implantation may be at least one selected from the group consisting of hydrogen, silicon, germanium, fluorine, oxygen and carbon. The constituent substance of the semiconductor substrate, such as Si is preferably used for the ion implantation. In such a solar cell structure having the crystal defect or amorphous layer, relatively long wavelength light that could not effectively be utilized in the prior art solar cell may be utilized so that the photoelectric conversion efficiency may be improved.

33 Claims, 8 Drawing Sheets